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SPECIES OF THE *EMOIA SAMOENSIS* GROUP OF LIZARDS
(SCINCIDAE) IN THE FIJI ISLANDS, WITH
DESCRIPTIONS OF TWO NEW SPECIES

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ABSTRACT: *Emoia* lizards, generally referred to as *E. samoensis* in the Fiji, Samoa, and Tonga islands, actually represent four distinct species, two of which are newly described. *Emoia samoensis* and *Emoia murphyi* are limited to the Samoa and Tonga islands; three species, *Emoia concolor*, *E. trossula* n. sp., and *E. cambelli* n. sp. occur in the Fiji Island group. A key to the species of the *Emoia samoensis* group in the Samoan, Tonga, and Fiji islands is provided.

INTRODUCTION

The Fiji Island group in the South Pacific Basin, about midway between Vanuatu (formerly New Hebrides) to the west and the Samoa and Tonga islands to the east, is comprised of about 320 islands. Several small, limestone and coral islands surround a number of larger, ancient, volcanic islands. The principal large islands are Viti Levu, Vanua Levu, Taveuni, Kadavu, Ovalau, Koro, Gau, Rabi, and Moala.

The Fijis are the Pacific outpost for amphibians, with two endemic species of the ranid genus *Platymantis*. Other terrestrial vertebrates include a number of endemic species, and some endemic genera. Until recently, however, no species of the scincid lizard genus *Emoia* were

thought to be endemic to the Fijis. The recognized species were the apparently wide ranging ones, *E. caeruleocauda*, *E. cyanura*, *E. nigra*, *E. samoensis*, and possibly *E. cyanogaster*.

The present study is primarily concerned with those populations of the *E. samoensis* evolutionary line that occur in the Samoa, Tonga, and Fiji islands and that have generally been referred to the species *E. samoensis*. Other species of this evolutionary line that have previously been recognized as distinct from *E. samoensis* are not considered in detail, although some of them are included in Table 1 and the key at the close of this paper.

The (evolutionary) line of the genus *Emoia* includes species which range from relatively small, *E. parkeri*, to the largest in the genus, *E.*

TABLE 1. SCALE COUNTS AND OTHER PERTINENT CHARACTERS FOR SPECIES OF THE *Emoia samoensis* GROUP OF SPECIES IN THE SAMOA AND FIJI ISLANDS.*

	Snout-vent length at maturity (mm)	Number in sample for scale counts	Midbody scale rows	Scale rows between parietals and base of tail	Fourth toe lamellae
<i>E. campbelli</i> n. sp. (Fiji Islands)	68.9-97.8	13	30-36	56-65	44-56
<i>E. concolor</i> (Viti Levu Island)	61.3-78.9	16	28-32	56-60	44-52
<i>E. concolor</i> (other Fiji Islands)	52.8-88.9**	66	28-34	54-66	44-64
<i>E. murphyi</i> (Samoa and Tonga islands)	52.2-74.9	14	26-32	52-58	59-82
<i>E. nigra</i>	85.0-121.0	20	33-40	59-72	30-39
<i>E. parkeri</i>	44.5-53.8	18	28-32	52-59	34-43
<i>E. samoensis</i> (Samoa Islands)	78.0-118.0	21	30-34	58-68	45-54
<i>E. trossula</i> n. sp. (Fiji Islands)	66.0-103.0	37	32-38	62-76	52-54

* Four other species of *Emoia* occurring in these islands belong to other groups (evolutionary lines).

** This size range is based on 50 adults. One specimen measuring 100 mm from Vanisea, Kandavu Islands is referred to this species with some reservations.

nigra. The genus may be characterized as follows: habitus varies from slender to fairly stout; snout moderately tapered and slightly to moderately depressed; subdigital lamellae usually broadly rounded (moderately thinned for two species), and number 30-82 under the fourth toe; number of midbody scale rows 26-42; number of paravertebral rows between parietals and base of tail 52-84; frontoparietals fused; interparietal nearly always distinct, ranging from long and narrow to small; nasal bones separate; parietal eye present; alpha-type palate. This group of species ranges through the south Pacific Islands from Samoa in the east to Vanuatu and Bismarcks in the west.

Emoia samoensis and *E. concolor* were the first species of this group to be described (Duméril 1851). The type locality for *samoensis* was given as Samoa and that for *concolor* as Ambon, an island in the Moluccas to the west of New Guinea. The latter locality was not given in the original description, but subsequently by Jacquinot and Guichenot (1853). Peters (1877) described another species of this complex, *E. resplendens*, from the Fijis, stating that the type was in the Godeffroy Museum.

Boulenger (1887) recognized the close relationship of these three species and placed *E. concolor* and *E. resplendens* in the synonymy of *E. samoensis*. Most later authors (e.g., Werner 1899; Schmidt 1923; Burt and Burt 1932; Smith 1937; Brown 1956), followed this synonymy, assigning specimens from various islands between Samoa and Vanuatu to *E. samoensis*. Exceptions were Roux (1913) who described a race of *samoensis*

from the Loyalty Islands and *E. speiseri* and *E. nigromarginata* from Vanuatu, Burt (1930) who described *E. murphyi* from Samoa, and Schmidt and Burt (1930) who described *E. sanfordi* from the Vanuatu and Solomons. Medway (1974) described yet another species, *E. aneityumensis*, from Vanuatu. At the same time, these authors as well as Medway and Marshall (1975) continued to refer all Fiji specimens as well as examples from some populations in Vanuatu to *E. samoensis*.

Brown (1953:20) recognized that the species *E. concolor* was distinct from *E. samoensis*, but without examining the types and assuming the type locality to be Ambon, erroneously suggested that the species might belong to the *E. physicae* group.

Thus it was not until the 1970s that field work in the Fijis by several zoologists, J. C. Pernetta, D. Watling and W. Beckon among them, began to raise serious questions about the taxonomic status of the Fijian *Emoia* populations. Both Pernetta and Beckon pointed out the coexistence of uniformly colored populations and more typical dark-spotted or banded *samoensis*-like populations on various islands in the Fiji group. Several of the uniformly colored specimens were compared with the type specimens of *E. concolor* by W. C. Brown and were judged to belong to the same species. This evidence, supported by the fact that no examples of the species other than the types have ever been recorded from Ambon, was interpreted as an indication that the types of *E. concolor* were doubtless from the Fijis, and

the locality Ambon was in error. In a subsequent paper, Pernetta and Watling (1979) listed both *E. samoensis* and *E. concolor* (the latter apparently endemic) as occurring in the Fijis, and noted differences in habit as well as color pattern but not other characters for the two groups of populations represented in their samples. Beckon (personal communication) also recognized *samoensis* and *concolor*, suggesting that both could probably be divided into several island races or subspecies. Brown et al. (1980) described a second endemic Fijian species, *E. parkeri*, which is usually related to *E. nigromarginata* from Vanuatu.

The purpose of this study is to determine the status of those populations of *Emoia* (previously referred to *E. samoensis*) in the Samoa, Tonga, and Fiji islands.

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wealth Scientific and Industrial Research Organization, Australia, and The Penrose Fund of the American Philosophical Society. Field work of the junior author was funded by the University of the South Pacific Research Committee.

MATERIALS AND METHODS

We have examined the types of *Emoia samoensis*, *E. concolor*, and *E. murphyi* as well as other examples from the Samoan and Tonga islands. In addition, relatively large samples of *E. sanfordi* from Vanuatu and populations on some of the Fiji Islands, as well as small samples (one to a few specimens) from other islands of the Fijis have also been studied. Data on size at maturity, size of eye, length of snout, length of limbs, variation in color patterns, and scale characters such as number of midbody scale rows, paravertebral scale rows between the parietals and the base of the tail, the number of lamellae beneath the fourth toe of the hind foot, and the pattern of the squamation of the head were determined.

RESULTS

Our analysis of populations in the Samoa, Tonga, and Fiji islands, which were generally referred to *Emoia samoensis*, have shown that these populations represent five distinct taxa. We treat them as separate species and provide detailed descriptions of *E. samoensis* and the Fijian species.

Emoia samoensis (A. Duméril)

Eumeces samoensis (part) Duméril, 1851:157 (type loc.: Samoa; type in Muséum National d'Histoire Naturelle, Paris); Jacquinot and Guichenot, 1853:10, in Hombron and Jacquinot 1853.

Emoia samoensis (part) Girard, 1858:265.

Lygosoma samoense (part) Boulenger, 1887:293; Sternfeld, 1920:407; Boettger 1893:106; Boulenger, 1897:307.

Emoia samoensis (part) Burt and Burt, 1932:531; Mertens, 1934:160; Smith, 1937:227; (part) Brown, 1956:1487; Mittleman, 1952:30; Greer, 1970:171.

Emoia samoense, Schwaner, 1980:8.

Duméril (1851:157) described *Eumeces samoensis* on the basis of two specimens in the Muséum National d'Histoire Naturelle in Paris which were said to be from Samoa. He also attributed the name to Hombron and Jacquinot based on an illustration published earlier (sometime between 1845 and 1851). This illustration

is part of Plate V in the Atlas (1845–1853) which accompanied Jacquinot and Guichenot's text (1853). However, the plate bears only the French name *Eumeces* de Samoa and therefore does not establish publication of the valid scientific name.

Scale counts and color (even in the faded condition) of the syntypes of *Emoia samoensis*, however, indicate that only one of them (MNHN 7070) is in close agreement with other examples from the populations in the Samoa Islands. And even though the head is damaged on one side, this specimen must be chosen as the lectotype. The second syntype (MNHN 7070a), the undamaged one and the one apparently used for the illustration in Hombron and Jacquinot, even in its present faded condition, exhibits some distinct white longitudinal dashes on the dorsum (prominent in the illustration), which are typical of most examples of the larger, previously undescribed species from the Fijis.

MATERIAL EXAMINED.—Samoa Is. (without definite locality): MNHN 7070 (syntype), 81; RMNH 3103; ZMC 373–374; BMNH 66.8.25.2; MCZ 3951, 8963. Upola Is.: CAS 157233; MCZ 69487; AMNH 29241, 29245; BMNH 1969.631–633; AM R1473. Tutuila Is.: CAS 50236–38; CAS-SU 13600–603, 18071; AMNH 27206, 27695, 27702, 27706. Savaii Is.: AMNH 41737–38, 41744. Tau Is.: AMNH 27668–73, 27675–76. Western Samoa: BMNH 1969.622–24, 1969.628–30.

LECTOTYPE (NEW DESIGNATION).—MNHN 7070, collected on Samoa during the voyage of the *Astrolabe* and the *Zelee*, 1837–1840.

DESCRIPTION OF LECTOTYPE.—Adult male, snout-vent length 105+ mm; head damaged but most head-shield characters recognizable; rostral broader than high, forming slightly curved suture with frontonasal; prefrontals in contact; frontal damaged but was in contact with first and second supraoculars; four large supraoculars; interparietal moderate size; anterior loreal about as long as posterior, in contact with first and second and probably third upper labials; sixth upper labial on right side enlarged and beneath eye; dorsal scales smooth, vertebral rows not distinctly enlarged; 32 midbody scale rows; 59 paravertebral rows between parietals and base of tail; 52 rounded lamellae under fourth toe; 16 under first toe.

COLOR (IN PRESERVATIVE).—Surface layer lost from most scales, but remaining undamaged scales indicate a dorsal pattern of olive green with blackish blotches.

DEFINITION (BASED ON SAMPLE OF ABOUT 20 SPECIMENS).—A relatively large *Emoia*, snout-vent length 78–118 mm for 120 mature males

and 84–114 mm for 80 mature females (data from Schwaner 1980:8); habitus moderately stout with well-developed limbs; snout moderately tapered, rounded at tip, its length 36–40% of head length and 56–68% of head breadth; head breadth 57–60% of head length and 13–16% of snout-vent length; eye moderate, its diameter 52–73% of snout length and 30–42% of head breadth; ear diameter $\frac{1}{2}$ – $\frac{2}{3}$ of eye diameter with three or four small lobules anteriorly; rostral broader than high, forming moderate, nearly straight suture with frontonasal; prefrontals in moderate contact (occasionally narrowly separated); frontal longer than broad, about as long as or slightly longer than fused frontoparietals, broadly rounded posteriorly, in contact with first and second supraoculars; four large supraoculars; six to seven supraoculars; interparietal moderately long and narrow to moderately wide; parietals in contact posteriorly; one pair of nuchals; anterior loreal shorter than to about as long as and higher than posterior loreal, in contact with first and second, second and third, or first, second, and third upper labials; six to eight upper labials, sixth (rarely fifth or seventh) largest and beneath eye; usually seven lower labials; scales smooth, paravertebral rows not enlarged or only slightly enlarged; 30–35 midbody scale rows (very rarely greater than 34); 58–68 paravertebral rows between parietals and base of tail; limbs well developed, length of extended hind limb 86–110% of axilla-groin distance and 46–54% of snout-vent length; 45–54 rounded lamellae beneath fourth toe; 13–16 lamellae beneath first toe; rank of adpressed toes from longest to shortest four, three, two through five, one; tail longer than body.

MEASUREMENTS (IN MM) OF LARGE FEMALE (CAS 50238).—Snout-vent length 107.0; axilla-groin distance 54.4; hind limb length 55.2; head length 25.6; head breadth 16.0; snout length 9.6; eye diameter 6.2; ear diameter 2.1.

COLOR (IN PRESERVATIVE).—Dorsal ground color is greenish-tan to tan, marked with few to numerous dark brown spots varying from less than scale-size to vague, irregular transverse bands or partial bands involving several scales in transverse rows. Occasionally these show short whitish bars as in *E. trossula*. The venter is yellowish ivory to dusky tan. The top of head is not distinctly darker than the body.

NOTE ON REPRODUCTION.—Schwaner (1980:8) states that the clutch size for 30 specimens ranges

FIGURE 1. *Emoia concolor*.

from 4–7 eggs. He gives a snout-vent length of 31 mm for one hatchling.

HABITAT NOTE.—Schwaner (1980:8) states that examples of this species were found primarily on tree trunks and low vegetation at heights from near ground level to several meters. This skink is diurnal.

RANGE.—This species occurs in Samoa.

Emoia concolor Duméril

(Figure 1)

Euprepes concolor Duméril, 1851:62 (type loc.: Fijis (?); type in Muséum d'Histoire Naturelle, Paris).

Emoia samoensis (part) Girard, 1858:264.

Euprepes samoensis (?) Steindachner, 1867:44.

Euprepes resplendens Peters, 1877:416.

Lygosoma samoense (part) Boulenger, 1887:293.

Lygosoma cyanogaster (part?) Boettger, 1893:106.

Lygosoma cyanogaster tongana (part, Fiji Islands) Werner, 1899:375.

Emoia samoense (part) Schmidt, 1923:52.

Emoia samoensis (part) Burt and Burt, 1932:531; (part) Smith 1937:227; (part) Brown, 1956:1487; Greer, 1970:171; (part)

Pernetta and Watling, 1979:236.

Emoia concolor, Pernetta and Watling, 1979:236.

As noted in the introduction, this species has long been regarded as a synonym of *E. samoensis*, the latter having been thought to range from Samoa to Vanuatu and to be the only species of

the complex represented in the Fijis. Only recently has *E. concolor* been recognized as a valid species and name correctly applied to some Fijian populations.

Peters (1877) based his brief description of *E. resplendens* on a single example from Ovalau Island. Several early specimens labeled *L. samoense* of the Godeffroy Museum collections are now in the Zoologisches Museum, Universität Hamburg, so it is reasonable to assume that the type specimen of *E. resplendens* was also transferred to that museum. However, Professor Hans Wilhelm Koepeke (personal communication) states that many of the herpetological types (including *E. resplendens*) and type catalogues were lost or destroyed during World War II. Thus the status of *E. resplendens* (Peters) must be based on the original description.

Peters's count for midbody scale rows (30) and note on color, "metallic gold luster with numerous, dark brown dots arranged in transverse lines," would indeed seem to identify this specimen as an example of *E. concolor*, since this color pattern is exhibited by some examples of *E. concolor* from various islands. Thus, basing our conclusion on Peters's data and color description, we regard *E. resplendens* as a synonym of *E. concolor*. Werner's (1899:375) specimen

from the Fijis, which was referred to *E. cyanogaster tongana*, is almost certainly an example of *E. concolor* although he states that there are only 26 midbody scale rows.

Emoia concolor, though similar to *E. samoensis* in midbody scale rows, is a smaller species than either *E. samoensis* or *E. trossula* and typically has fewer scale rows between the parietals and the base of the tail, and more frequently exhibits a nearly uniform color on the dorsum.

Emoia concolor has a wide range in the Fijis, and there is evidence that some island populations differ sufficiently from one another to warrant recognition as subspecies. However, pending the availability of samples from as yet unexplored islands and larger samples from some already explored we hold such a decision in abeyance.

MATERIAL EXAMINED.—Fiji Is. (without definite locality): MNHN 7084, 7084a (syntypes); AM R6448a-b, 6449a-b, 6450a-c, 6451a-c; MCZ 9133, 9144; BMNH 55.11.7.24, 63.5.11.14-15, 75.12.31.10-13. Eastern Lau Group: AMNH 41750, 40195, 48058. Moala Is.: AMNH 41708. Kadavu Is.: BMNH 82.8.29.169-70; AM R30442, 30445; MCZ 15014, 16943-44; FMNH 3497; CAS 155974-85. Cikobia Is.: AMNH 29007. Vanua Levu Is.: BMNH 87.8.25.41; Pernetta coll. 252, 282. Viwa Is.: Pernetta coll. 117-119, 122-123. Yaduataba Is.: CAS 156002-04. Dravuni Is.: MCZ 16930-40; FMNH 3498a-d. Nagasan Is. (=Yagasa Is.?): MCZ 16947-48. Lamu Is.: MCZ 48958. Viti Levu Is.: MCZ 16459; FMNH 62796, 69241, 69639, 71764, 71772; BMNH 1940.1.17.7, 1945.11.5.9, 1947.3.1.86; Pernetta coll. 181, 167, 203, 205, 207-90; FM RA1, 4, 12, 43; CAS 102361, 156136-37. Matuku Is.: USNM 230221-26. Kori Is.: USNM 230019-21. Ovalau Is.: FMNH 170716, 13641; USNM 230104-05. Taveuni Is.: BMNH 1959.1.2.32. Rotuma Is.: BMNH 97.7.29.8. Gau Is.: Watling coll. 501, 526, 543. Bird Is. (small island near Viti Levu): AM R109939-43.

LECTOTYPE.—MNHN 7084, collected during the voyage of the *Astrolabe* and the *Zeele*, 1837-1840.

DESCRIPTION OF LECTOTYPE.—Male, 87 mm snout-vent length; rostral broader than high, forming long, nearly straight suture with frontonasal; prefrontals in moderate contact; frontal longer than broad, about as long as frontoparietals and interparietal, in contact with first and second supraoculars; four large supraoculars; interparietal moderate in size; frontoparietals fused; one pair of nuchals; anterior loreal nearly as long as and not much higher than posterior, in contact with second upper labial and supranasal; sixth upper labial enlarged and under eye; some dorsal scales with three or four faint keels; paravertebral rows not enlarged or only slightly enlarged; 34 midbody scale rows; 60 paravertebral rows be-

tween parietals and base of tail; 60 moderately rounded lamellae beneath fourth toe; 16-17 beneath first toe; tail longer than body.

COLOR (IN PRESERVATIVE).—Relatively uniform yellowish olive-green on dorsum and upper lateral surfaces; lower lateral surfaces have bluish tinge and venter dirty ivory.

The following definition, based on a series of more than 50 specimens, provides data on the variation exhibited by this species.

DEFINITION.—An *Emoia* of moderate size, snout-vent length 52.3-88.7 mm for 22 males and 52.8-73.5 mm for 6 females (the sex of the syntype at 87 mm has not been determined, also a unique specimen, FMNH 3497, labeled from Vunisea on Kadavu Island and measuring about 100 mm, is referred to this species with some reservations); habitus moderately slender; snout moderately tapered, rounded at tip, its length 35-42% of head length and 55-66% of head breadth; head breadth 52-68% of head length and 13-17% of snout-vent length; eye diameter 52-70% of snout length and 30-45% of head breadth; ear diameter $\frac{1}{3}$ - $\frac{1}{2}$ of eye diameter; ear usually with three small, rather pointed lobules anteriorly; rostral broader than high, forming a long, straight or slightly concave suture with frontonasal; supranasals long and narrow, in contact with anterior loreal; prefrontals in moderate contact (rarely very narrowly separated); frontal longer than broad, usually longer than fused frontoparietals, broadly rounded posteriorly, in contact with first and second supraoculars; four large supraoculars; interparietal of moderate length and breadth; parietals in contact posteriorly; one pair of nuchals; anterior loreal somewhat shorter than to nearly as long as posterior and slightly higher, in contact with first and second, second, or first, second, and third upper labials; seven or eight upper labials, sixth (very rarely fifth) enlarged and beneath eye; usually seven lower labials; dorsal scales smooth or with two or three weak striations; paravertebral rows not enlarged or scarcely enlarged; 28-34 (see Table 1) midbody scale rows; 54-63 paravertebral rows between parietals and base of tail; limbs well developed; length of extended hind limb 89-104% of axilla-groin distance and 44-54% of snout-vent length; 46-68 rounded lamellae under fourth toe and 14-18 beneath first toe; rank of adpressed toes from longest to shortest four, three, two through five, one; tail longer than body.

FIGURE 2. *Emoia trossula*.

MEASUREMENTS (IN MM) OF MALE (AM 6448A).—Snout-vent length 73.5; axilla-groin distance 34.8; hind limb length 36.0; head length 19.3; head breadth 11.7; snout length 7.4; eye diameter 4.8; ear diameter 2.0; tail broken.

COLOR (IN PRESERVATIVE).—Dorsal ground color is nearly uniform greenish tan or with a few scattered brown spots or short bars to nearly solid, brownish longitudinal stripes (see Fig. 1); ground color more greenish yellow on lower lateral surfaces; venter more yellowish white or nearly turquoise (pale yellow to lime green in life); top of head and lower limbs often somewhat darker tan than rest of dorsum; sometimes yellow spots on posterior surface of thighs; digits sometimes with dark brown, transverse bands.

NOTE ON REPRODUCTION.—Three hatchlings measure 26.3–28.1 mm in snout-vent length. Gravid females have two eggs.

HABITAT NOTE.—*Emoia concolor* is a lowland species from sea level to 500 m. It occurs both in the relatively open, intermediate-zone woodlands and lowland forests, and in agricultural and suburban areas such as coconut and mango groves.

RANGE.—This species is widely distributed in the Fiji Islands. Steindachner's 1869 reference to

Stuart Island is presumably Unganga Island in the Fijis which some nineteenth century charts call Stuart.

Emoia trossula n. sp.

(Figure 2)

Eumeces samoensis (part) Duméril, 1851:157.

Lygosoma samoense (part) Boulenger, 1887:293; Werner, 1899:375.

Emoia samoense (part) Schmidt, 1923:52.

Emoia samoensis (part) Burt and Burt, 1932:531; (part) Brown 1956:1487; (part) Pernetta and Watling, 1979:236.

This distinctively colored species from the Fijis has long been confused with *E. samoensis*. Even one of the two syntypes of the latter in the National Museum in Paris (MNHN 7070a), although indicated as being from the Samoa Islands in the catalogue, is an example of this species. It exhibits the color pattern and scale counts of the Fijian populations referred to this species (see also p. 44).

HOLOTYPE.—AM R30433, an adult male, collected on Ovalau Island, Fijis, 6 May 1970, by Harold G. Cogger.

PARATYPES.—Fiji Is. (without specific locality): MNHN 7070a (one of syntypes of *E. samoensis*), 5573, 5573a–b; USNM 58155, 58166; AMNH 20927; AM R6446, R8566, A9463; BMNH 75.12.31.6, 62.10.23.4. Ovalau Is.: FMNH 13642,

13644-45; AM R30586, R30616-18; AMNH 40491. Yauataba Is.: USNM 230301; CAS 156128-29, 155960-62. Kadavu Is.: AM R30446; AMNH 40489; BMNH 82.8.29.185. Aiwa Is.: AMNH 29917-22. Koro Is.: AMNH 40506. Thithia Is.: AMNH 40196. Moala Is.: AMNH 40223. Vatu Vara Is.: CAS 156130; AMNH 29010-11. Gau Is.: AMNH 40503. Buki Levu Is. (possibly part of Kadavu): MCZ 16945. Lakeba Lau Is.: MCZ 16965. Doi Lau Is.: MCZ 16941-42. Tuvuca Is.: AMNH 40539; BMNH 81.10.12.10. Namena Is.: BPBM 1504; AMNH 40441-43, 40445. Taveuni Is.: CAS 155958; BMNH 1938.8.2.9. Viti Levu Is.: ZMH R01976-77. Rotuma Is.: BMNH 97.7.29.9-10, Gau Is.: Watling coll. 524-25, 541-42. Kia Is. (a small island near Viti Levu): R116160.

BMNH 1860.3.18.8 and 1860.3.18.11, which were purchased from Mr. Cuming, are stated to be from Eumonga and Vanuatu. However, since they agree in most characters with examples from populations of *E. trossula* from the Fijis and not with samples from any of the species known from Vanuatu, we assume that the locality data are probably in error and have referred these two specimens to *E. trossula*, but have not included them in the paratypes.

DIAGNOSIS.—This species differs from other species of the *Emoia samoensis* group in the following combination of characters: (1) 32-40 (rarely less than 34) midbody scale rows; (2) 62-76 paravertebral scale rows between the parietals and the base of the tail; (3) 42-54 lamellae under the fourth toe; (4) snout-vent length for adults 66.5-103.0 mm; (5) some features of color pattern that are generally present, such as short, narrow, greenish white longitudinal dashes on dorsum and upper lateral surfaces. These dashes are more or less in rows occupying the middle region of the concerned scales and are most prominent on the lighter, dorsal transverse bands and above the spaces between the dorsolateral dark blotches.

DESCRIPTION.—A relatively large *Emoia*, snout-vent length 67.0-101.6 mm for 7 mature females and 66.5-103.0 mm for 14 mature males (2 specimens measuring 58.7 and 69.0 mm appear immature); habitus moderately stout with well-developed limbs; snout moderately tapered, rounded at tip, its length 33-39% of head length and 51-65% of head breadth; head breadth 56-60% of head length and 13-17% of snout-vent length; eye moderate, its diameter 60-81% of snout length and 34-48% of head breadth; ear diameter about $\frac{1}{3}$ - $\frac{1}{2}$ of eye diameter, with three or four small, white lobules anteriorly; rostral broader than high, forming a moderate, slightly concave suture with frontonasal; supranasals slightly broader anteriorly than posteriorly, in contact with anterior loreal; prefrontals narrowly separated to moderately in contact; frontal longer than broad, about as long as fused frontopari-

etals, rounded posteriorly, in contact with first and second supraoculars; four large supraoculars; interparietal relatively long and moderately narrow; parietals in contact posteriorly; one pair of nuchals; anterior loreal slightly shorter than to nearly as long as posterior and slightly higher, usually in contact with first and second, second only, or first, second, and third upper labials; six to eight upper labials, sixth (rarely fifth or seventh) largest and beneath eye; usually seven lower labials; scales smooth for adults, a hatchling with faint keels; middorsals only slightly enlarged; 32-38 (very rarely less than 34) midbody scale rows; 61-76 paravertebral rows between parietals and base of tail; limbs well developed, length of extended hind limb 96-109% of axilla-groin distance and 47-53% of snout-vent length; 43-54 rounded lamellae beneath fourth toe and 13-16 beneath first toe; rank of adpressed toes from longest to shortest four, three, two through five, one; tail longer than body.

MEASUREMENTS (IN MM) OF HOLOTYPE, AN ADULT MALE.—Snout-vent length 94.3; axilla-groin distance 48.2; hind limb length 49.1; head length 22.4; head breadth 14.3; snout length 8.6; eye diameter 6.45; ear diameter 2.6; tail length 140.

COLOR (IN PRESERVATIVE).—Ground color of the dorsum and upper lateral surfaces nearly uniform medium brown to greenish olive-brown, or most often marked by irregular, lighter and darker transverse bands and by a series of dark blotches on the dorsolateral surface.

Usually there are few to numerous, narrow, greenish white, longitudinal dashes occupying the median part of each affected scale. These are primarily on the lighter bands and above the dark, dorsolateral blotches, usually in longitudinal rows. The lower lateral surfaces are bluish gray fading into the bluish white of the venter which is lightly to densely spotted or flecked with small, black marks, at least posteriorly.

ETYMOLOGY.—The name *trossula* is from the Latin meaning dandy, and refers to the colorful spotting like a brightly colored coat.

COMPARISONS.—The number of paravertebral rows (62-76) is greater than that of other species of the *E. samoensis* group except for *E. anceitymensis* from Vanuatu which it barely overlaps. Also, the white dashes in the dorsal color pattern (nearly always present) are most prominent in this species. Boulenger (1887:294), Werner (1899:375), and Burt and Burt (1932:531) noted these white markings for some specimens but did not

FIGURE 3. *Emoia campbelli*.

observe that they were primarily limited to Fiji specimens. Nor did they have a sufficiently large series to recognize that in addition to being divisible on the basis of two color patterns, the Fiji samples also show bimodal curves for the number of midbody scale rows and scale rows between parietals and base of the tail.

Emoia trossula is most closely related to *E. samoensis*. They are similar in size, but *E. trossula* differs in color pattern and has a greater number of midbody scale rows and a slightly higher number of paravertebral rows between the parietals and the base of the tail (see Table 1). *Emoia sanfordi* from Vanuatu is also a large species but differs in color pattern and has a much greater number of lamellae. *Emoia concolor* is smaller than *E. trossula* and has a lower number of midbody scale rows.

NOTE ON REPRODUCTION.—Gravid females have two to five large eggs in the oviducts. One hatchling measures 32.3 mm from snout to vent.

HABITAT NOTE.—This species is primarily a semi-arboreal forest form. On Yaduataba Island it was found both in the trees and on the forest floor. Some specimens were also seen asleep on open tree branches. Such habits as well as its relative boldness may have led to its extinction on many islands, possibly due to predation by

mongooses and feral cats. Beckon's notes indicate that in inhabited areas on Taveuni Island this species was found in trees but on Kadavu Island this species was found in the forest, on or near the ground. On Gau Island *E. trossula* was found from the coastal areas up to an elevation of about 650 m in the rain forest.

RANGE.—This species now has a patchy distribution in the Fiji Islands and is almost certainly extinct on the main islands of Viti Levu and Vanua Levu. The two specimens in the Hamburg Museum (ZMH R01976–77) that are recorded from Viti Levu were collected early in the nineteenth century. It is suggested that the introduction of the mongoose in 1887 may have led to this extinction. This theory would appear to be indirectly supported by the fact that *E. nigra*, a primarily terrestrial skink of about the same size as *E. trossula*, is also absent from Viti Levu but common on some other islands on which *E. trossula* still occurs. Thus far *E. trossula* has been recorded from the Fiji Islands.

***Emoia campbelli* n. sp.**

(Figure 3)

HOLOTYPE.—CAS 156256, an adult female collected by John Gibbons in the upper canopy of the cloud forest at Monsasavu



FIGURE 4. Section of "Ant plant" showing chambers in which eggs of *Emoia campbelli* were found.

on the Rairaimatuku Plateau at an elevation of about 750 meters on Viti Levu Island in December 1983.

PARATYPES.—CAS 155967-73, CAS 156257-58, CAS 156710-12 and USPM 46-48 from the same locality as the holotype; Viti Levu Island: ZMH R01978.

DIAGNOSIS.—The species can be distinguished from other species of the *E. samoensis* group on the basis of the following combination of characters: (1) midbody scale rows 30-36 (rarely below 32); (2) scale rows between parietals and base of tail 56-64; (3) fourth toe lamellae 48-54; (4) snout-vent length at maturity 69-98 mm; (5) prefrontals in relatively broad contact; and (6) color pattern: usually large, pale (yellowish in life) blotches along dorsolateral margin, separated by short, irregularly margined, blackish bars. (These spots are small or very faint in two specimens.)

DESCRIPTION.—A moderate sized to relatively large *Emoia*, snout-vent length 70.4-97.8 mm for four males and 68.9-96.0 mm for five females (a female measuring 64.2 mm is apparently immature); habitus moderately stout with well-developed limbs; snout rather strongly tapered, rounded at tip, its length 56-68% of head breadth and 35-42% of head length; head breadth 56-70% of head length and 13-17% of snout-vent length; eye moderate, its diameter 56-72% of snout length and 33-43% head breadth; ear diameter 33-40% of eye diameter; rostral broader than high, forming long, nearly straight suture with frontonasal; supranasals narrowly triangular, in contact with anterior loreal; prefrontals in moderately broad contact; frontal longer than broad, about as long as fused frontoparietals, in contact with first and second supraoculars; four large supraoculars; interparietal moderate; pa-

rietals in contact posteriorly; one pair of nuchals; anterior loreal nearly as long as posterior, in contact with first and second, second and third, or first, second and third upper labials; seven or eight upper labials, sixth (rarely seventh) enlarged and beneath eye; six or seven lower labials; scales smooth; middorsal scales slightly enlarged; 30-36 (rarely less than 32) midbody scale rows; 56-64 paravertebral rows between parietals and base of tail; limbs well developed, length of extended hind limb 88-107% of axilla-groin distance and 45-52% of snout-vent length; 44-56 rounded lamellae under 5th toe; 14-17 under 1st toe; rank of adpressed toes from longest to shortest four, three, two through five, one; tail longer than body.

MEASUREMENTS (IN MM) OF HOLOTYPE.—Snout-vent length 97.8; axilla-groin distance 48.0; length of hind limb 45.6; head length 21.6; head breadth 13.8; snout length 8.9; eye diameter 5.0; ear diameter 1.7; tail length 136.

COLOR (OF FRESHLY PRESERVED SPECIMENS).—Middorsal three or four rows of scales grayish to grayish olive green or light grayish brown, marked by black spots or dashes (in some specimens the black scales form either broken or very irregular transverse bands). Top of head is usually darker (slate brown), occasionally the same as the body; upper lateral surfaces usually marked by small to large (two to eight scales), yellow blotches alternating with black blotches between the nape and the groin (they are evident for some examples of both sexes); lower lateral surfaces mottled grayish tan and bluish green marked by blackish flecks and dashes; venter bright sulfur yellow to greenish yellow, often with a blood red diffusion posteriorly, and on the base of the tail in life (fading in preservative); with small black dashes posteriorly, along midline, on prenasals and sometimes base of tail.

ETYMOLOGY.—This species is named for Mr. John Campbell, who collected the first example of this species in the Monasavu area.

NOTE ON REPRODUCTION.—Eggs of this species have been found in the chambers of "ant plants." Figure 4 shows the chambers in a section of one of these plants. One gravid female has two large eggs.

HABITAT NOTE.—Field observations by the junior author indicate that this species uses as shelter primarily, if not exclusively, "ant plants" of the genus *Hydnophytum*, epiphytic in trees in the montane forests. It forages on the branches of

the trees. Only one juvenile has been found on the ground.

RANGE.—This species has thus far been found only on the Nadrau Plateau in the mountains of Viti Levu Island.

COMPARISONS.—*Emoia campbelli* is probably most closely related to *E. concolor* and *E. nigromarginata*. It differs from both in color pattern, a slightly higher number of midbody scale rows, and a somewhat larger size. It also differs from *E. nigromarginata* in the somewhat greater number of lamellae.

The morphological differences separating *E. campbelli* from *E. concolor* are not as great as those separating *E. trossula* from *E. concolor*, and we were at first inclined to regard this population as a montane subspecies of *E. concolor*. However, *E. campbelli*, based on our available sample from the Monasavu area on the Rairaimatuku Plateau (part of the Nadrau Plateau), 750 to 1,200 m elevation, in the montane rain forest, is apparently strictly arboreal, at least in the adult stage. Also it seems to prefer the arboreal "ant plant" as a resting place and even deposits its eggs in cavities of that plant. Furthermore the montane forests of the plateau are effectively isolated from the lowland forest on three sides by high vertical cliffs and by a partially grassland corridor on the fourth side. *Emoia concolor* is a less specialized, primarily lowland species, which is at home in a variety of habitats, many of them much drier than the montane forest (see note on habitat for *E. concolor*). Because of its specialized habitat preference and isolation, we treat *E. campbelli* as a distinct species.

DISCUSSION

Much larger samples were available to us than to earlier authors, and we were able to assess more accurately the limits of variation for many populations and therefore more clearly define species and determine their ranges. As stated in the introduction and the diagnostic key, the populations from the Fijis represent taxa distinct from *E. samoensis* in the Samoa Islands.

Emoia samoensis generally attains a larger size than does *E. concolor* from the Fijis although these two overlap in scale counts and color pattern. *E. trossula* n. sp. is similar in size to *E. samoensis* and *E. sanfordi* from Vanuatu, but differs from these as well as from *E. concolor* in some scale counts (Table 1) and usually in some

features of the color pattern. *Emoia campbelli*, the other new Fiji species, is thus far known only from a population on the Nadrau Plateau in the mountains on Viti Levu Island. For most species of the *E. samoensis* complex the dorsal color tends to vary, but the basic patterns are different. The least variation is characteristic of *E. campbelli* and *E. trossula*. The latter only infrequently exhibits a nearly uniform brown or greenish olive brown color on the dorsum. *Emoia concolor*, as presently diagnosed, exhibits a uniform greenish color, or various patterns of brownish markings. Also, for *E. concolor* at least on Viti Levu, individuals exhibiting a uniform pattern are found almost exclusively in the coastal and open woodlands of the lowlands while those exhibiting varying density of dark spots, often bands or lines, on the dorsum occur primarily in the more dense lowlands and montane forests (see Perretta and Watling 1979). These authors assigned these apparent color morphs to *E. concolor* and *E. samoensis* respectively.

Emoia murphyi is closely related to *E. concolor* and *E. trossula* is closely related to *E. samoensis*.

The following key and table set forth the diagnostic characters and known ranges for the seven species included in this study. Populations in Vanuatu heretofore identified with *E. samoensis* must be reexamined to determine their true taxonomic status and relationship to other species of *Emoia* now recognized as occurring in Vanuatu and the Loyalty Islands.

KEY TO THE SPECIES OF THE *EMOIA SAMOENSIS* GROUP IN THE SAMOA AND FIJI ISLANDS

- 1a. Midbody scale rows 26–36 (rarely greater than 34) 2
- 1b. Midbody scale rows 32–40 (rarely less than 34) 3
- 2a. Fourth toe lamellae 30–39; snout-vent length at maturity 85–121 mm; interparietal very small; dorsal and upper lateral surfaces dark brown to almost black, nearly uniform, with scattered pale spots, or sometimes with vague, irregular transverse bands *E. nigra*
- 2b. Fourth toe lamellae 42–54; snout-vent length at maturity 66–103 mm for 20 specimens; interparietal long; dorsal color pattern greenish olive brown to medium brown usually with darker blotches or

- bands and with few to numerous whitish dashes (Fiji Islands) *E. trossula* n. sp.
- 3a. Fourth toe lamellae 34–43; snout-vent length at maturity 46–54 mm; color pattern marked by a golden bronze head, a greenish bronze to greenish blue vertebral stripe about two scale rows in breadth; bordered by a blackish or dark brown band with scattered pale scales; a similar band on the upper labial surface (Fiji Islands) *E. parkeri*
- 3b. Fourth toe lamellae 44–83 (very rarely less than 45); snout-vent length at maturity 52–118 mm; color variable but not as above 4
- 4a. Fourth toe lamellae 59–82 (rarely less than 63); color of dorsum dull grayish to grayish tan, darker posteriorly with a few vague dark and light spots, especially dorsolaterally (known from Samoa and Tonga islands) *E. murphyi*
- 4b. Fourth toe lamellae 44–66 (very rarely greater than 62); color of dorsum usually greenish tan, with or without darker markings 5
- 5a. Midbody scale rows 30–36 (very rarely fewer than 32, mean 33.1); color pattern of middorsal area greenish olive with scattered, dark and light spots or sometimes nearly complete, dark and light bands; dorsolateral area usually marked by a series of large pale to yellowish blotches separated by narrow, blackish bars (mountains of Viti Levu Island, Fijis) *E. campbelli*
- 5b. Midbody scale rows 28–35 (rarely greater than 32); color variable but not as above 6
- 6a. Scale rows between parietals and base of tail 54–63 (rarely greater than 60); snout-vent length at maturity 53–88 mm; color pattern of dorsum, four phases: (1) relatively uniform greenish to greenish tan, (2) greenish, marked by few to numerous brown to blackish spots, (3) dark spots in narrow longitudinal lines, or (4) occasionally marked by a series of pale and dark (in preservative usually brownish) more or less complete, transverse bands (Fiji Islands) *E. concolor*
- 6b. Scale rows between parietals and base of tail 56–68 (rarely less than 58); snout-vent

length at maturity 78–118 mm; color pattern of dorsum: (1) nearly uniform greenish to greenish tan; or (2) with scattered brownish to blackish spots, sometimes forming transverse bands, very rarely marked by whitish dashes (Samoa)

E. samoensis

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